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# Integrated Groundwater Management

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Anthony J. Jakeman • Olivier Barreteau •  
Randall J. Hunt • Jean-Daniel Rinaudo •  
Andrew Ross  
Editors

# Integrated Groundwater Management

Concepts, Approaches and Challenges

 Springer Open



*Editors*

Anthony J. Jakeman  
National Centre for Groundwater  
Research and Training  
Fenner School of Environment  
and Society  
Australian National University  
Canberra, ACT, Australia

Olivier Barreteau  
IRSTEA  
UMR G-EAU  
Montpellier, France

Randall J. Hunt  
Wisconsin Water Science Center  
US Geological Survey  
Middleton  
Wisconsin, USA

Jean-Daniel Rinaudo  
Water Department  
BRGM, French Geological Survey  
Montpellier, France

Andrew Ross  
National Centre for Groundwater  
Research and Training  
Fenner School of Environment  
and Society  
Australian National University  
Canberra, ACT, Australia

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## Foreword

I am delighted to introduce *Integrated Groundwater Management*, a text I consider an essential contribution to the water management field exploring relevant governance, biophysical, socioeconomic and decision support standpoints as they relate to the issue of groundwater.

Groundwater is a vital resource for humans, the environment and planet earth as a whole. It provides over 97 % of accessible freshwater on the planet. Half of the world's drinking water and nearly half of irrigation water for agriculture come from groundwater.

Groundwater is the sole source of water in many regions; in most other regions, it becomes a crucial buffer resource when other sources are not sufficient. As our increasing reliance on it demonstrates, groundwater depletion, pollution, and impacts on dependent ecosystems are pressing issues for humanity worldwide.

Contemporary groundwater management has moved well beyond a concern with how much water is stored underground or can be extracted from aquifers. Today we recognise that integrated, effective and efficient groundwater management relies on pulling together work in a variety of disciplines such as climate science, ecology, socioeconomics, public policy and law, as well as hydrogeology. However, whilst we realise the importance of multiple perspectives and a diversity of contexts and data, the challenge of integrating and organising all of this information into a decision making framework remains.

It is also abundantly clear that sharing and access to water is a fundamentally political issue and that solutions depend on full engagement of stakeholders as well as mobilisation of knowledge and technologies.

Consider some of the issues covered in the book: groundwater dependent ecosystems, managed aquifer recharge, the impacts of climate change on groundwater availability, water supply and security, conjunctive use of surface and groundwater, safeguarding environmental and cultural flows, and other cross-sectoral issues particularly with respect to energy. These are just a few of the pressing, contemporary, international issues that will demand not only rigorous interdisciplinary groundwater science but must be managed in ways that appreciate and consider the variety of contexts in which the problem exists. The book argues how we can progress and solve such scientific, management and policy problems using a thoughtful and thorough process that involves: problem framing and ensuing

conceptual modelling with interest groups; understanding the social, policy and institutional settings, constraints and opportunities; and focusing the science components on the identified questions, attributes and scales of interest. Often the components are best integrated into more computational models so that the effects of policy drivers can be gauged along with non-controllable forces like climate and trade conditions on outcomes. Outcomes of a triple bottom line nature will also need to be identified as trade-offs and their uncertainty managed so that one can more confidently decide among alternative courses of action. An overriding theme should always be appropriate engagement in all stages of the process so that knowledge is shared, trust is engendered and adoption of good outcomes is more likely.

This book was initially conceived by the National Centre for Groundwater Research and Training in Australia to address a substantial gap in the literature on the interdisciplinary aspects of addressing groundwater-related issues. From this initial conceptualisation, it grew to encompass work occurring worldwide, and now brings together some 74 world leading authors with broad ranging expertise in all facets of integrated groundwater management, in a wide variety of hydrologic and human settings.

The combined experience, insights, and learnings laid out in the pages of this book hold the key to progressing groundwater management as we know it, in a complex and interrelated world. The case for and value of problem-focused interdisciplinary research put forward by the authors, absolutely necessary for integrated groundwater management, are compelling. Each chapter reveals new approaches to a world interconnected by groundwater. These ideas, knowledge and experience illustrate how future effective decision making will hinge on integrating the larger environmental, social and political context into groundwater management. It reveals the components of a powerful *applied* interdisciplinary toolkit, how it works in theory and in practice and, to my mind, why it is absolutely necessary.

This book succeeds in moving well beyond the clichés of interdisciplinarity that one often hears. It shows us, in vivid and illustrative ways, precisely how interdisciplinarity can enhance and transform decision making and resource management in practice. Just as important, it indicates the fallacy of management “solutions” when such interdisciplinary thinking is necessary but missing. It pushes us to understand how research is conducted at, and across, disciplinary interfaces. It points to the vital and transformational payoffs for these additional efforts.

Integrated groundwater management can be academically challenging and interesting. But most importantly, it is essential to ensuring sound and defensible groundwater management that is based upon rigorous and problem-centred interdisciplinary science. Simply put, current and foreseeable groundwater management problems cannot hope to be truly addressed without considering the wide variety of approaches promoted here.

The book explores one of the most important grand challenges in our discipline and presents a vision for groundwater science and management in the twenty-first century. Integrated groundwater management underpinned by rigorous interdisciplinary science will be vital for wise stewardship of groundwater into the future.

I believe that this book is a pioneering contribution. We, as a community of researchers, technicians, managers and policy makers, are the fortunate benefactors of the editors' and authors' collective efforts. I wholeheartedly commend this book to you as a quintessential and inspirational must-read. If we rise to, and learn from, the challenges and opportunities set out in this book, the often bleak predictions for water resources in the future can include more hopeful and effective alternatives, with immeasurable benefits for current and future generations.

National Centre for Groundwater Research  
and Training, Bedford Park, SA, Australia  
Flinders University, Bedford Park, SA, Australia  
Australian Academy of Technological Sciences  
and Engineering, Melbourne, VIC, Australia

Craig T. Simmons, FTSE

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